Overview

- About SCE
- Historical program
- Current program
- Desired future program
  - Help shape potential new capabilities
  - Be aware of cost effectiveness and the maturity of technology

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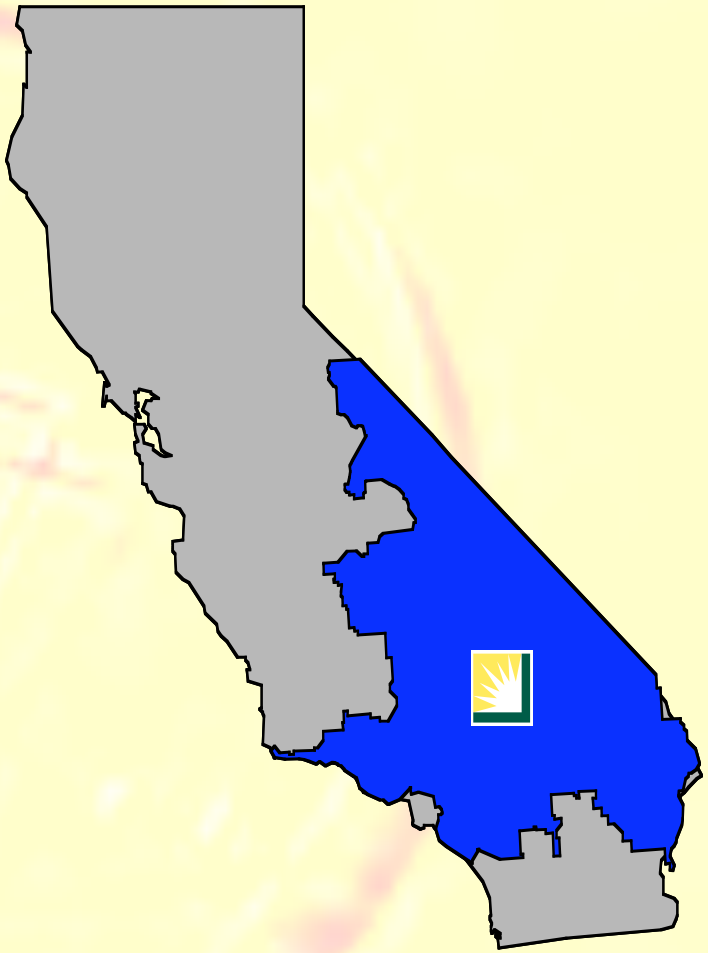
Southern California Edison

- SCE is one of the nation's largest electrical utilities with 4.67 million customers in its 50,000 square mile territory serving 430 cities and communities
- Over 13,000 Employees
- 70,000 New Customers currently added each year
- 5396 Transmission and Distribution circuits & 857 Substations
- SCE, founded in 1897; has over a century of experience serving its communities



Southern California Edison

SCE's Commitment to Technological Advancement

- SCE has interconnected 2,700 projects and 200+ MW of customer owned and operated DER with its grid since 1998
- Rising customer expectations and the needs of a technology driven economy demand superior safety and reliability from tomorrow's distribution circuits….at no increase in cost
- Advanced technology will make this possible
- SCE has a proud history of innovation and support for new technologies used to provide quality, low cost, electrical service to its customers

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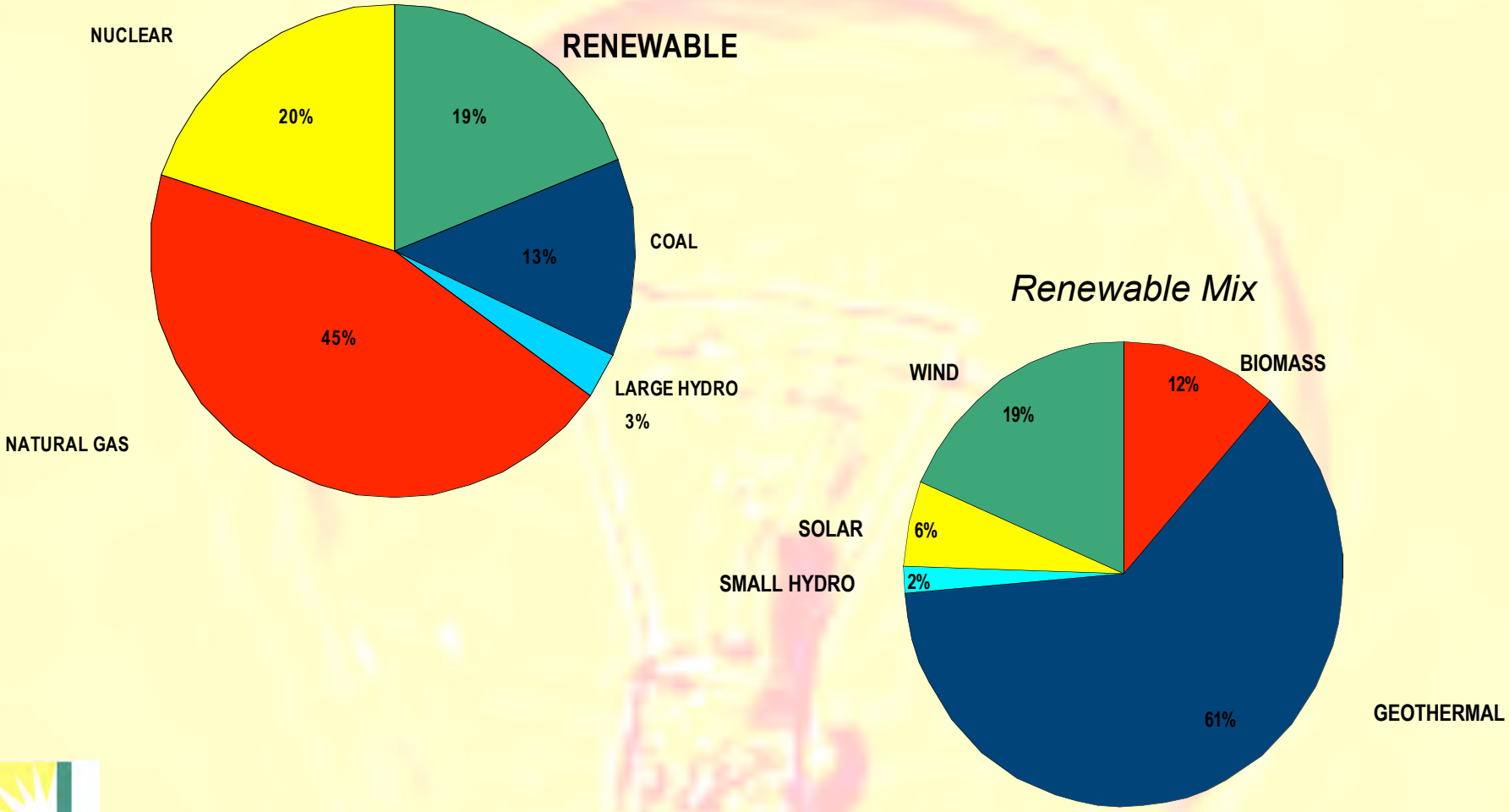
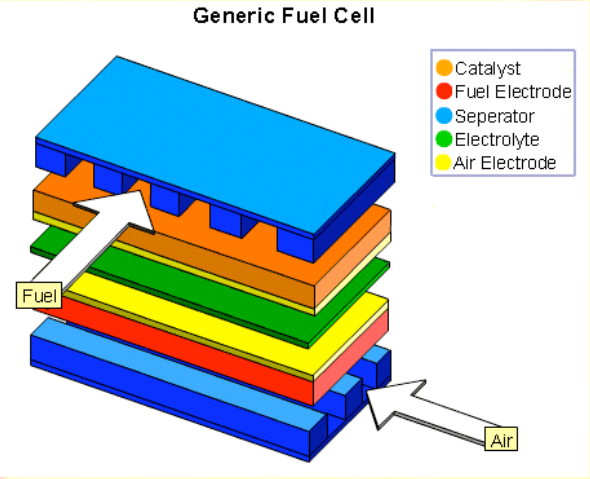
Nearly 20% of the Energy Delivered to SCE's Customers is from Renewable Energy Sources



Year End 2004

SCE's Historical Activities with Fuel Cells

- Operated 40 kW PAFC on landfill gas-1985
- Participated in two MCFC demonstrations
  - 2 MW Santa Clara Project - 1994
  - 250 kW Unocal Project (transferred to Mira Mar Air Station) – 1995
- Operated 25 kW SOFC
  - Natural gas
  - Logistic fuel
- SCE established National Fuel Cell Research Center (NFCRC) in 1994 at SCE's Highgrove
- SCE transferred NFCRC named to UCI in 19974
- SCE participated in several government and commercial planning activities- SCAQMD, LAMTA, DOE & Canadian Government



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SCE Tested First Hybrid Fuel Cell

- Why Hybrid Technology?
  - Solid oxide fuel cells (SOFCs) are clean, reliable power generators with efficiencies exceeding 50%.
  - Small MTG's operating characteristics match the SOFC technology.
  - The hybrid combination of a SOFC and a MTG offers more efficient power system than any other similar sized technology.

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SCE Testing Experience with Hybrid Fuel Cell

- Test & Demo Goals
  1. Achieve peak power of 250kW (from the PSOFC and the MTG)
  2. Achieve an efficiency of 57% at 220 kW based on the lower heating value of the fuel
  3. Achieve Un-manned operation
  4. Achieve 3,500 hr operations
  5. Evaluate system and component reliability
  6. Offer design evaluation for commercial system

- Results
  1. 182 kW net AC
  2. 53% electrical efficiency
  3. Achieved Unmanned operation
  4. Achieved 2,000 hrs. operation
  5. Propriety information
  6. Propriety information

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Distributed Generation Can Have Value

- Current Research at SCE
  - Microturbine Testing
  - Communication & Control
  - DER and Grid Optimization
  - Distribution System Demand Management
  - Solid Oxide Fuel Cells
  - Reactive Power Sources
  - Improved DC-AC Inverters & Controls

- Electric service customers with high thermal loads can improve efficiencies and lower costs with combined heat and power applications
- Operations with high reliability or power quality requirements often use DG to meet their needs
- Utilities with temporary capacity needs can use portable DG units as a stop-gap measure until permanent solutions can be arranged
- “Free” fuel resources can often be utilized with small generation located at the fuel source

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CARB Distributed Generation Emissions Standards Goal – Meet Central Power Plant Emissions with Best Available Control Technology

Four out of the five generators that meet the 2007 emission standards are fuel cells

	2003 Emissions Standards lbs/MWH	2007 Emissions Standards lbs/MWH (g/MWH)
Oxides of Nitrogen (Nox)	0.50	0.07
Carbon Monoxide (CO)	6.00	0.10
Volatile Organic Compounds (VOC)	1.00	0.02
Particulate Matter (PM)	An Emissions Limit corresponding to Natural Gas with no more than 1 grain/100 scf	An Emissions Limit corresponding to Natural Gas with no more than 1 grain/100 scf

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Fuel Cell Technologies Receive A "Most Favored Status" In California

• In recognition of their high efficiencies and low emission characteristics, California law provides several benefits for utility customers using Fuel Cells to supplement their electric service:

✓ Fuel Cell generation is exempted from most interconnection, standby and departing load charges,

✓ SCE has established a "net energy metering tariff" that allows customers using Fuel Cell generation to "bank" surplus energy produced for consumption at another time

✓California's Self Generation Incentive Program provides $2.50/ KW incentives to Utility Customers installing Fuel Cells

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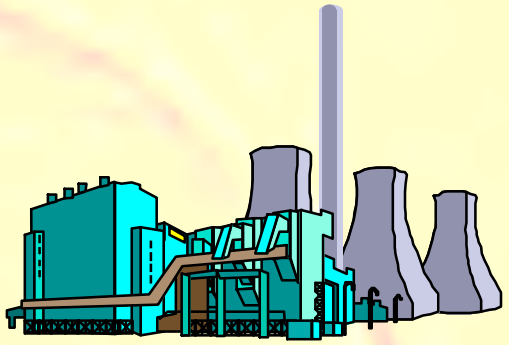
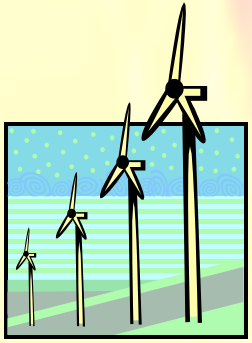
Generation Operational Options for SCE Customers

- "Supplemental" or "Bypass" Generation (Parallel or Isolated)
- Net Energy Metering (Solar, Wind, & Animal Waste Only)
- Merchant Generation (Scheduling Energy with ISO)
- "Qualifying Facility" units may sell energy directly to SCE



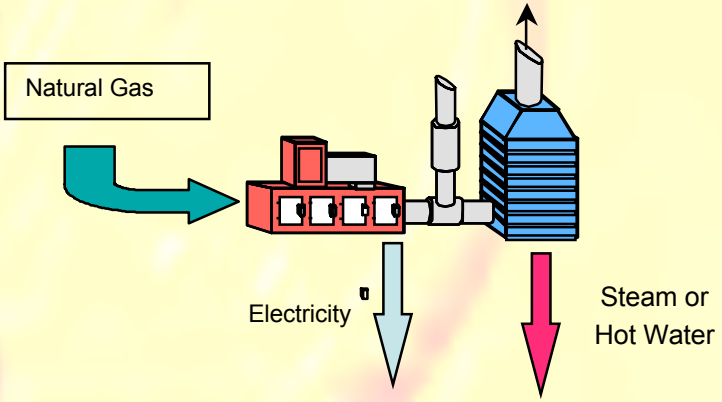
Large Central Power Plant



Wind

Solar

Biomass



Cogeneration

Self Generation Incentive Program

- The Self Generation Incentive Program (SGIP) provides financial incentives for the installation of new, qualifying self-generation equipment installed to meet all or a portion of the electric needs of a facility

- SGIP complements the existing CEC's Emerging Renewables Program (ERP) by providing incentive funding to larger renewable and non-renewable self-generation units up to the first 1.0 MW in capacity

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SCE's Customer Distributed Generation Base

Technology	Interconnections Authorized between 1/1/98 and 12/31/05		Projects in Development	
	Number of Projects	Total kW	Number of Projects	Total kW
Microturbines (< 250 kW)	61	10,564	12	2,660
Gas Turbines (> 250 kW)	3	6,769	2	11,800
Internal Combustion Engines (< 5,000 kW)	114	113,326	43	75,354
Large Projects (IC-GT ≥ 5,000 kW)	7	99,061	-	-
Fuel Cells	**5**	**305**	**-**	**-**
Small Hydro	1	643	1	250
Combined Technologies (PV/MT, IC, or GT)	3	8,485	1	740
Net Energy Metered (NEM) (Includes PV, Wind, Biogas, and Renewable Fuel Cells)	3,780	35,750	556	17,257
Total	**3,974**	**274,903**	**615**	**108,061**

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2005 SGIP Incentive Rates/Guidelines[1] - The Rebates

$115M State Program with $30M administered by SCE

Incentive Levels	Eligible Technologies	Incentive Offered $/Watt	Minimum System Size	Maximum System Size	Maximum Incentive Size
Level 1	**Renewable fuel cells**	**$4.50/W**	30 kW	5 MW	1 MW
	Photovoltaics	$3.50/W			
	Wind turbines	$1.50/W			
Level 2	**Non-renewable fuel cells**	**$2.50/W**	None	5 MW	1 MW
Level 3-R	Renewable fuel microturbines	$1.30/W	None	5 MW	1 MW
	Renewable fuel internal combustion engines and large gas turbines	$1.00/W			
Level 3-N	Non-renewable and Waste Gas fuel microturbines	$0.80/W	None	5 MW	1 MW
	Non-renewable and Waste Gas fuel internal combustion engines and large gas turbines	$0.60/W			

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SCE Sees Fuel Cells as a Promising, and Maturing Generation Technology

Technology	Size Range, kW	Current Installed Capital Cost, $/kW	Heat Rate Btu/kWh	NOx Emissions lb/MWh
Distributed Generation				
Microturbines	28 - 250	1,300 - 3,000	13,000 - 15,000	0.50 - 0.70
Small Gas Turbines	1,000 – 10,000	1,000 - 1,500	10,000 - 14,000	0.727 - 1.216
Internal Combustion Engines	100 - 3,000	1,000 - 2,000	9,000 - 13,000	0.9 - 1.50
Fuel Cells	**10 - 2000**	**4,000 - 6,000**	**7,000 – 7,500**	**0.016**
Photovoltaics	10 -200	7,000 - 10,000	-	0
Wind	10 - 750	1,850 - 3,500	-	0
Central Generating Plants				
New combined cycle plants	>100,000	600 - 800	6,300 - 7,200	0.022

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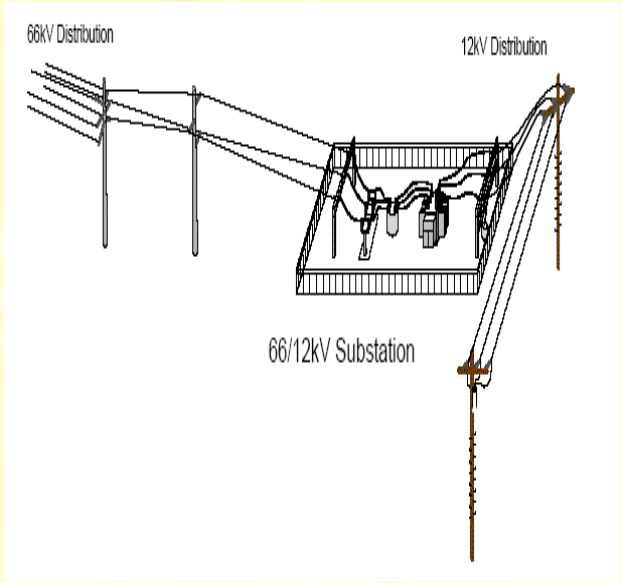
Utility Planning Issues

- "Fleets" of DG units will be needed to supplant a central power station
- A typical utility 12 kV distribution feeder serves 8-10 thousand kW at peak times
- Typical utility distribution substations serve more than 100 thousand kW of customer load
- It will require 50 – 200 kW or 2000 – 5 kW Fuel Cells to supply the peak loads served by one distribution feeder
- SCE is investigating the communication and control requirements necessary to integrate many small generators into the utility's operation



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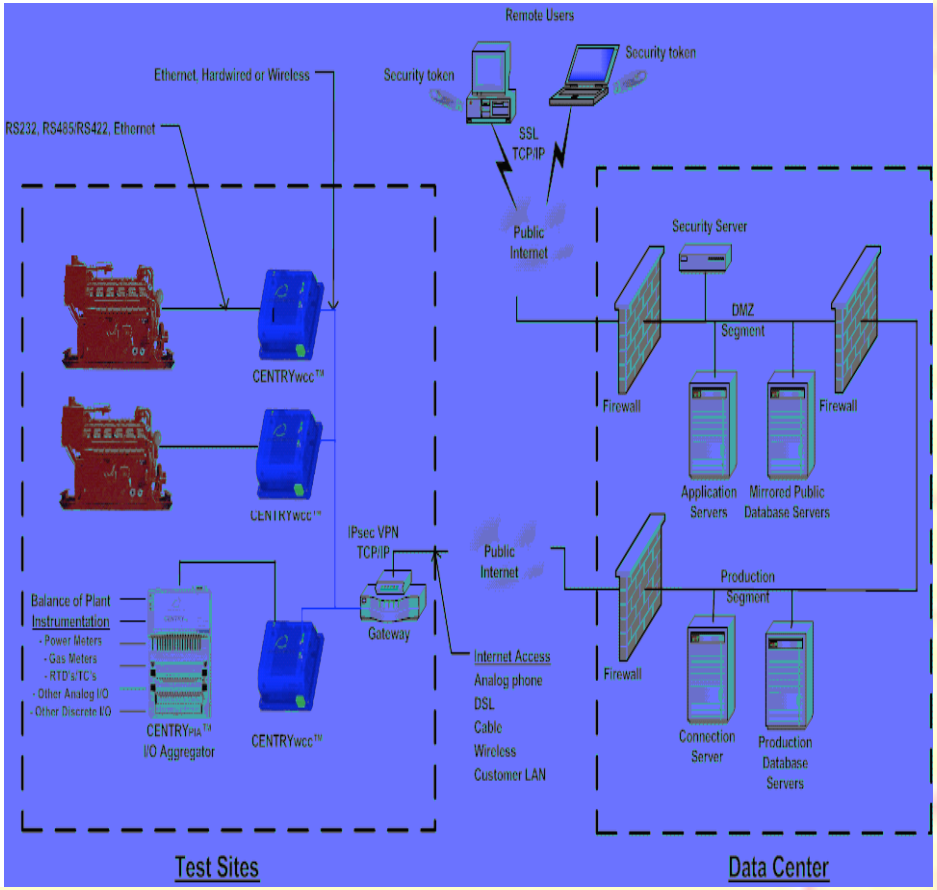
Advanced Communications and Control



- This project demonstrates secure Internet monitoring and control of DER in an individual and aggregated manner.
  - Phase 1 -- SCE's Catalina units monitored (05/03-05/04)
  - Phase 2 -- LA County Sanitation District four DG units with over 50 MW of DER to be monitored (08/04-02/06)
  - Future phase: Further integrate aggregated DG with Demand Response (DR) from a common C&C capability
- Vision toward aggregated DG market monitored and controlled by multiple parties with differing authority
- Connected Energy - project lead, DOE funded with CEC funding for DR
- Total Project funding: $2.8 million

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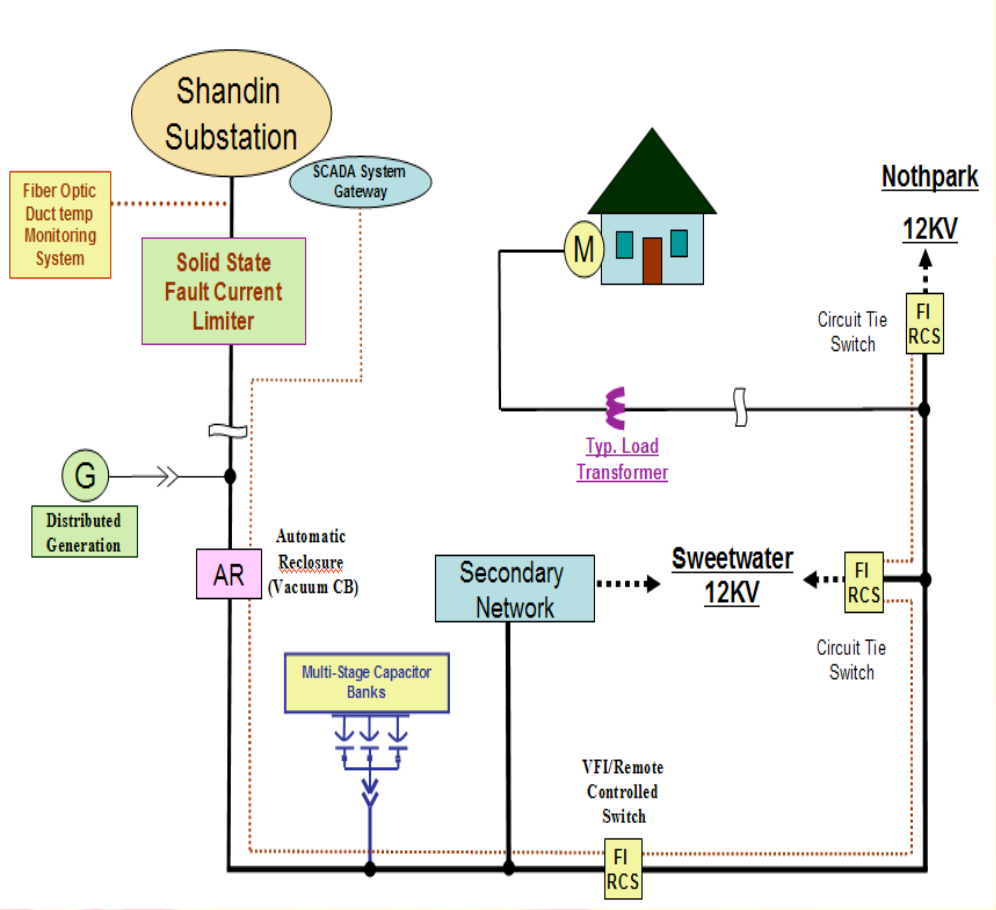
Temporary DER and Portable Generation Facilities

- Purpose is to evaluate the use of temporary DER for grid support
- Will provide improved grid reliability under stressed conditions
- Project is a part of SCE's Circuit of the Future initiative which includes many other new technologies:
  - Potential opportunities VAR control and load management
  - Improved operations
  - Intelligent distribution circuits
  - Peer to peer coordination for auto circuit reconfiguration
  - Added Intelligence



Is there a Future For Fuel Cells at SCE or Other Utilities?

- $400/kW Fuel Cells could revolutionize the utility industry
  - Distributed generation of any type that is competitive (cost, efficiency, and environmentally) with utility "central plant" technologies will spawn the next generation of utility service
  - Multiple generation points will require a much more robust communication & control infrastructure
  - Fuel supply systems will need to be revamped to match the requirements of an electric system with distributed generation
  - Reliability and security requirements will dictate utility oversight and control

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The Use of Distributed Generation is an interactive process

- Utilities balance service quality, selection, and costs
- DER is expected to expand – Utilities, customers, and regulators need to continue to address business and regulatory models
- DER should reduce costs and complement utility service for all utility customers

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SCE Engineering Advancement

- **Engineering Advancement Mission:**
  - EA leads Research, Development and Deployment of Technical Innovation to make SCE's Grid Smarter, more Cost Effective, and Safer to Operate and Maintain
  - Goal to enhance security, power delivery, and reliability
- Distributed Energy Resources (DER)
  - Develops and implements programs using distributed generation, energy storage and demand response technologies to improve the operational efficiency and effectiveness of SCE's distribution and transmission grids.
  - Maintains SCE's position as an influential leader in DER
  - SCE helped forge revisions to Rule 21 to facilitate the interconnection of smaller DER facilities

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Thank You

Questions ?

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